

**The Ohio State University College of Public Health
PUBHEHS 6330
Environmental Epigenetics
3 credits – Spring 2022**

Instructor: Min-Ae Song, PhD
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Instructor's Office Hours:

If students have general questions, clarifications, confusion, or comments regarding the course, please use the weekly discussion board. Also, digital office hours are available based on the feedback or need of the students. Please schedule an appointment with me via my email at Song.991@osu.edu.

TA Name, email, and office hours: to be added

TA responsibilities: The TA assigned to the course will hold regular office hours and lead review sessions for any students who need help with class material. The TA may assist with scoring assignments and exams; however, the professor will assign final grades. **Any questions regarding grading should be directed to the professor and not the TA.**

Course description: Epigenetics is an exciting and rapidly growing field of science, with increasing applications in molecular biology, epidemiology, and environmental science. Epigenetics is the study of biological mechanisms that will influence exposed host gene expression without altering DNA sequences. Individuals' epigenetic patterns can change over time by different environmental influences that explain a link between nature and nurture. For example, how identical twins with the same genetic information show different susceptibilities to disease. One of the mechanisms is changes in DNA methylation. The course will provide a solid foundation in epigenetics and introduce the underlying mechanisms of epigenetic control of gene expression, major laboratory methods, and research applications in molecular biology, epidemiology, and the environmental sciences.

Textbook: There is no required textbook for this course. For those who want some broader background reading, an optional book is "[Environmental Epigenetics](#)," Su, L. Joseph, Chiang, Tung-chin (Eds.) (ISBN 978-1-4471-6678-8)

Prerequisites: Undergraduate-level biology (ex., Biology 1113 or 1114) or related discipline or permission from the instructor

Class Delivery: This course is a 100% online distance learning course. There are 15 weekly and asynchronously delivered course sessions consisting of topic-specific modules for a total of 160 minutes equivalent instruction time per module. Each module includes two related topics. All course activities and resources can be found through our course website on Carmen Canvas. We will touch on many different topics during the semester; however, we will not cover any one topic in-depth. This class incorporates (1) weekly recorded lectures and/or related videos, (2) online weekly quizzes, (3) weekly practice activities, (4) homework assignments, (5) weekly discussion boards, (6) online resource activities, and (7) additional readings. Please note: It is a self-paced online course that does not mean self-study. Students must log into course sites regularly and interact through the class discussion boards and on projects and assignments. Overall, earlier modules include more basic concepts of environmental epigenetics and methods to understand the later modules for real-research application.

Students should take a syllabus quiz during the first week and get 90% correct at the beginning of the semester using a Canvas Quiz in order to access the course materials.

Expectations of Students: This is an entirely online course and divided into **weekly modules** (i.e., there are no times at which we all gather together in person or virtually). The design allows for more

flexibility, but it also puts more responsibility on you to effectively manage your time and learning. Therefore, please plan well and always try to get course activities and assignments done well ahead of due time to avoid something that may occur unexpectedly at the last minute. You should plan to spend a minimum of 9 hours each week on this course and to log-in multiple times per week to the site on Carmen. These expectations are further discussed in this syllabus.

Biology or relevant courses are required to take this course to succeed your learning in this course. If you feel in need of refreshing, I recommended reviewing relevant textbooks and materials from the biology class you took. Each individual would have a different need, so please feel free to contact me for additional materials for your need.

Carmen: There is a Carmen site for this course: <http://carmen.osu.edu>. All course materials, including the syllabus, recorded lectures, materials for practice exercises, homework assignments, exams, and other notices, are available via Carmen.

Course Learning Objectives: After completing this course, students will be able to:

- 1) describe general concepts of epigenetics, including DNA methylation, histone modifications, and microRNAs;
- 2) compare and contrast the study of genetics and epigenetics;
- 3) evaluate various technologies for DNA methylation analyses and their use in epidemiology, environmental health sciences, and molecular biological sciences;
- 4) describe the importance of the relationship between environmental exposures, lifestyle, and epigenetics;
- 5) summarize how environmental toxicants affect aging and human diseases; and,
- 6) apply epigenetic biomarkers for environmental exposure in epidemiology, environmental sciences, and molecular biological sciences.

Goals, Domains, Knowledge Objectives, and Competencies

All Graduate Degrees (MPH, MS, MHA, PhD): Foundational Public Health Knowledge Objectives

- Explain the critical importance of evidence in advancing public health knowledge (6).
- Explain effects of environmental factors on a population's health (7).
- Explain biological and genetic factors that affect a population's health (8).

MPH: Foundational Competencies

- Apply epidemiological methods to the breadth of settings and situations in public health practice (1).
- Interpret results of data analysis for public health research, policy or practice (4).

MPH: Specialization in Environmental Health Sciences

- Identify and explain individual (e.g., genetic, physiologic and psychosocial) and community (e.g., social, built, economic, race) susceptibility factors that heighten the risk for populations for adverse health outcomes from environmental hazards (4).
- Explain exposure and the underlying mechanisms of toxicity and infectivity resulting from chemical, biological and physical agents (6).
- Compare the principle components and influencing factors in the exposure continuum from source to disease (9).

MS: Specialization in Environmental Public Health

- Explain how the core public health concepts of biostatistics, epidemiology, environmental health, health behavior/health promotion, and health administration relate to the student's area of specialization (1).

- Synthesize literature in student's area of specialization relative to their thesis topic and its importance for public health (2).
- Communicate in writing and orally a research project's methods, results, limitations, conclusions and public health relevance (6).
- Explain individual and community susceptibility and vulnerability factors that heighten the risk for populations for adverse health outcomes from environmental hazards (7).
- Apply the environmental health paradigm (i.e., EHS Model) to characterizing hazardous physical, chemical and biological agents relative to sources, categories, exposure matrices/pathways, distribution, human exposures, responses, societal/regulatory actions, and technological controls (8).

PhD: Foundational Competencies

- Explain how the core public health concepts of biostatistics, epidemiology, environmental health, health behavior/health promotion, and health administration relate to the student's area of specialization (1).
- Synthesize and critique existing literature in student's area of specialization to identify gaps in the evidence base and justify their importance for public health (2).
- Analyze data and prepare an original manuscript, suitable for publication, summarizing the results and interpreting the findings from a research study (5).
- Communicate in writing and orally a research study's purpose, methods, results, limitations, conclusions and public health relevance to both informed and lay audiences (6).

PhD: Specialization in Environmental Public Health

- Quantify individual and community susceptibility and vulnerability factors that heighten the risk for populations for adverse health outcomes from environmental hazards (7).
- Apply the environmental health paradigm (i.e., EHS Model) to characterizing hazardous physical, chemical and biological agents relative to sources, categories, exposure matrices/pathways, distribution, human exposures, responses, societal/regulatory actions, and technological controls (8).

Grading: Course activities are comprised of the following activities listed below and will be graded as follows: All course materials will be found on Carmen. I will utilize the grade book feature in Carmen.

Participation (weekly discussion boards)	10%
Weekly Quizzes	10%
Weekly Practice activities	10%
Homework Assignments	10%
(choosing articles: 2%, writing: 2%, draft slides: 3%, final slides: 3%)	
Exam-1	20%
Exam-2	20%
Summary section	5%
Oral presentation (final)	10%
Online activities	5%

Any questions regarding grading must be addressed within one week of the return of the assignment.

Grading Scale:

A: 93 - 100 A-: 90 – 92.9
 B+: 87 – 89.9 B: 83 – 86.9 B-: 80 – 82.9
 C+: 77 – 79.9 C: 73 – 76.9 C-: 70 – 72.9
 D+: 67 – 69.9 D: 60 – 66.9
 E: < 60

Bonus Points: Additionally, the student can earn up to 6 points. These bonus points are added to your final oral presentation points.

- Midterm Course Evaluation (+3 bonus for completing it if there is 75% participation, anonymous)
- Final Course Evaluation (SEI, +3 bonus for completing it at the end of the semester if there is 75% participation, anonymous)

If you have any questions about grading, **please send me an email at Song.991@osu.edu** (I do not use the messaging feature in Carmen)

Course Activities and Assignments

Each topic's overview page has a detailed Roadmap, listing the items in the module and the work you must do. All materials for a module will be simultaneously available every Monday at 9 am for the entire week so that students can complete assignments at times that best fit their schedules.

Lectures: For each topic taught in this course, you will be required to watch pre-recorded lectures, slides, or videos and to read the related materials. Each topic will include two sub-topics (see table 1 below).

Participation (Weekly Discussion Boards, 2 points/week): This class will utilize discussion boards to foster critical thinking skills. You must respond to the prompt questions posted by the instructor on the discussion board. In addition to posting each week, you are required to respond substantively to one or more of your classmates' posts. You are required to post your original reply first before seeing the posts of others. Everyone is expected to follow the discussion throughout the week. Your writing should be your own original work. Grading will be based on a 0, 1, 2 scale: 0 indicates that the participation was not completed, or the effort was unacceptable; a 1 reflects moderate effort; a 2 reflects the expected level of effort.

Weekly Quizzes (7 points/week): Each lecture has an associated short online multiple-choice Weekly Quiz (taken via Carmen) to help reinforce understanding of the covered concepts. Students may take up to two attempts at each Weekly Quiz; if two attempts are taken, then the Weekly Quiz score will be the highest of the two. Please note that Weekly Quiz questions may be slightly different on the second attempt. A student cannot stop the Weekly Quiz, logout/log-in, and resume at a later time. Weekly Quizzes must be completed without the help of other individuals, but notes are okay.

Weekly Practice activities (2 points/week): Each lecture will include practice activities in various forms. The activities will be essential to understand underlying mechanisms of epigenetic control of gene expression (i.e., DNA methylation, histone modifications, and microRNAs), major laboratory methods including omics-based approach, and research applications in molecular biology, epidemiology, and the environmental sciences. The specific details of each assignment will be provided in each module. Grades will not be based on the accuracy of the responses but will reflect effort. Grading will be based on a 0, 1, 2 scale: 0 indicates that the assignment was not completed, or the effort was unacceptable; a 1 reflects moderate effort; a 2 reflects the expected level of effort. Please use the following naming configuration for your submission: **Lastname_Firstname_Practice_Week number** (e.g., Song_Min-Ae_Practice_Week 1).

Homework assignments (sequencing and scaffolding assignments): Throughout this course, there will be 4 homework assignments. It will be group work (2-5 students will be randomly grouped depending on the number of students). You should communicate with group members via Zoom, emails, or phones to complete each homework below. Detailed instructions will be provided in Carmen.

1. **Choosing two research articles (HW 1, 5 points):** Your group will need to select a specific topic on environmental epigenetics and read the two scientific articles with a similar topic of interest. You can use Google Scholar (<https://scholar.google.com/schhp?hl=en>) or Pubmed (<https://www.ncbi.nlm.nih.gov/pubmed/>). Potential topics will be provided in Carmen, but not limited to the example. One of the group members can submit two articles (2.5 points), but each of you should also submit a summary of your discussion (contributions) in the group meeting to choose the articles (2.5 points). Please use the following naming configuration for your submission: **Group #_Article-1_short title of the article 1**
2. **Writing (HW 2, 20 points):** You will need to write a summary, similar to those seen in scientific journals. It should be structured one summary by synthesizing two articles, including *Background (rationale), Materials and Methods, Results, and Conclusion*. This assignment may be discussed with other classmates, but the essay must be written independently. Grading will be based on content and style. The essay should be limited to 400 words and submitted with Arial 11-point font. This will be the basis of your slides and oral presentation. Your writing should be your own original work. Each of you should write your summary of two articles chosen using your own languages. Please use the following naming configuration for your submission: **Group #_Lastname_Firstname_Writing**
3. **Drafting PowerPoint slides (HW 3, 20 points):** Your group will be uploading a PowerPoint file (for 10-12 min presentation). It should be structured, including *Title, Reference articles, Main topic of the articles, Introduction, Materials and Methods, Results, and Conclusion, Limitations, and Strengthens, and Further Study*. Template slides will be provided in Carmen. Each group submits a draft PowerPoint (10 points), but each of you should submit a summary of your contributions to the draft slides (10 points). Please use the following naming configuration for your submission: **Group #_DraftSlides**
4. **Revising PowerPoint slides (HW 4, 20 points):** Your group will be uploading revised slides based on comments and suggestions from the instructor. Each group submits a revised PowerPoint (10 points), but each of you should submit a summary of your contributions to the draft slides (10 points). Please use the following naming configuration for your submission: **Group #_RevisedSlides**

Exams: There will be two exams. The format of the exams will include multiple-choice, short-answer questions, True/False, and essay-type responses. The exams will be designed to take ~1 hour, but 1.5 hours will be allowed. There are no make-up exams. If you must miss an exam, please contact me as far in advance as possible to discuss alternate arrangements. Any special arrangements for exams or submitting assignments will be made entirely at the instructor's discretion. You must complete the exams yourself, without any external help or communication. You should not use notes or class materials.

Summary section (30 points, 3 steps. All steps must be completed to earn full credit for assignment. Failure to do any part results in zero for assignment): Instead of taking an exam for the last part of the course, you will do an independent learning section. This section will include three steps as follow. **Step 1 (5 points)** requires you to choose a topic to explore in-depth. List of topics and instructions for sign up are in the assignment in Canvas. Once you have signed up, you will move on to **Step 2 (10 points)**, writing a reflection and summarizing the topic. Again, details are in the Canvas assignment. Once all students have posted Step 2 you will move on to the final step - **Step 3 (15 points)**. In this final part you will select the posts of two peers and respond according to the instructions in the assignment.

Oral presentation (Final, 45 points): A recorded 10-12 min presentation will need to be submitted. Each of you should present at least one slide in a group presentation. Each group submits a recorded

presentation, but each of you should submit (1) a summary of your contributions to the presentation and (2) a survey of peer review. Time management is important as content. Both draft and revised slides will need to be submitted as homework (see “Homework assignments” above). The revised slides should be presented. Oral presentations will be graded based on clarity and engagement, and a survey of peer review. More detailed instructions will be given in Carmen. Please use the following naming configuration for your submission: **Group #_ Recorded PPT**

Online resource activities (5 points for each): Students will do activities by navigating useful online resources. (1) Students will design an environmental epigenetic study (including aims, hypothesis, biospecimens, predictors/outcomes, implications, and limitations/strengths). (2) Students will be asked to navigate the “The UCSC genome browser” database to search genes and epigenetic marks and answer questions regarding summary information. More detailed instructions will be given in Carmen.

Note: If you have any questions about the lecture, Weekly Quizzes, practice activities, and homework assignments, do not message me directly but rather post to the Questions, Clarifications, Confusion discussion board found in your Canvas course.

Late policy: Students are expected to complete course activities (Weekly Quizzes, practice activities, homework assignments, and discussion boards) on time. Any activities not completed by the end of the week (Saturday by 11:59 pm) will be given a 0. There are no exceptions to this rule. If you believe you may be late, have a valid excuse, and wish to request an extension, please contact me by 8 pm the night before the course activity is due. Any late in-class assignments will be assigned a score of 1 unless an excuse is pre-approved.

Attendance: Your attendance is required and is based, at least in part, on your online activity and participation using Carmen. Student access to posted course modules and contents will be tracked to ensure ongoing access, activity, and productivity. University rules require students to participate in the online activity at least once per week. To meet this requirement, you will need to participate in discussion boards, take quizzes, submit activities and assignments. Due dates listed in the module (see Table 1)

Time Management: University rules stipulate that a student can expect to spend a minimum of approximately 3 hours per week on a course for each credit hour, thus for this 3 credit hour course, you should expect to devote **9 hours per week** total for the combination of class instructional time and outside homework. Workload will vary from week to week, with some weeks having more assignments and others having more active learning time. This is intended as a rough guide to help you plan your time accordingly. In a typical week, you can expect your time to be spent as follows:

- 3 hours – viewing pre-recorded lectures and related videos and practice activities
- 1 hour – completing weekly online quizzes
- 3 hours – completing weekly reading and homework assignments
- 1 hour – reviewing supplement materials
- 1 hour- completing discussion assignment

Course Communication

Announcements

We will be using Canvas for all aspects of course management. Please check the course homepage on Canvas for announcements, clarifications, and other class materials. You are required to subscribe to “Announcements,” which will notify you via email of a new posting.

Discussion Boards

These boards will be accessible to you throughout the entire semester. It is the best way to communicate with other technical support staff or me if you have questions. The two discussion boards are as follows:

- **Questions, Clarifications, Confusions:** Sharing questions and answers is a way to help each other. Use this discussion board to ask questions about course materials being covered that week (weekly discussion board). The idea is to recreate some of the classroom benefits in the online experience. Typically, when one student asks a question, others have the same question on their mind. I will respond and provide clarification on the discussion board to ensure that everyone has access to the same information. I will not respond to questions about course materials via email or through the messaging app in Carmen. However, if you want to schedule an appointment with me or if you have a question about a grade, please send me a message via my email at Song.991@osu.edu so that we can find a time to meet and discuss.

Course Technology

Technology skills needed for this course

- Basic computer and web-browsing skills
- Navigating Carmen (go.osu.edu/canvasstudent)
- CarmenZoom virtual meetings (go.osu.edu/zoom-meetings)
- Recording a slide presentation with audio narration (go.osu.edu/video-assignment-guide)
- Recording, editing, and uploading video (go.osu.edu/video-assignment-guide)

Required equipment

- Computer: current Mac (MacOs) or PC (Windows 10) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed and tested
- Microphone: built-in laptop or tablet mic or external microphone
- Other: a mobile device (smartphone or tablet) to use for BuckeyePass authentication

Required software

- Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365. Full instructions for downloading and installation can be found at go.osu.edu/office365help.

Carmen access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions (go.osu.edu/add-device).
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click Enter a Passcode and then click the Text me new codes button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application (go.osu.edu/install-duo) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service

Student Assistance

Office of Student Life: Disability Services: Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office of Student Life: Disability Services at 614-292-3307 in room 098 Baker Hall to coordinate reasonable accommodations for students with documented disabilities (<http://slds.osu.edu/>)

Student Support: A recent American College Health Survey found stress, sleep problems, anxiety, depression, interpersonal concerns, death of a significant other and alcohol use among the top ten health impediments to academic performance. Students experiencing personal problems or situational crises during the semester are encouraged to contact OSU Counseling and Consultation Services (292-5766; <http://www.ccs.osu.edu>) for assistance, support and advocacy. This service is free to students and is confidential.

Mental Health Services: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio

State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting <https://ccs.osu.edu/> or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org.

Academic integrity: Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University's *Code of Student Conduct* and the School's *Student Handbook*, and that all students will complete all academic and scholarly assignments with fairness and honesty. The *Code of Student Conduct* and other information on academic integrity and academic misconduct can be found at the COAM web pages (<https://oaa.osu.edu/academic-integrity-and-misconduct>). Students must recognize that failure to follow the rules and guidelines established in the University's *Code of Student Conduct*, the *Student Handbook*, and in the syllabi for their courses may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the University, or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Please note that the use of material from the Internet without appropriate acknowledgment and complete citation is plagiarism, just as it would be if the source were printed material. Further examples are found in the *Student Handbook*. Ignorance of the *Code of Student Conduct* and the *Student Handbook* is never considered an "excuse" for academic misconduct.

If I suspect a student of academic misconduct in a course, I am obligated by University Rules to report these suspicions to the University's Committee on Academic Misconduct. If COAM determines that the student has violated the University's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in the course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Anti-Racism Statement

The Ohio State University affirms the importance and value of diversity of people and ideas. We believe in creating equitable research opportunities for all students and to providing programs and curricula that allow our students to understand critical societal challenges from diverse perspectives and aspire to use research to promote sustainable solutions for all. We are committed to maintaining an inclusive community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among all members; and encourages each individual to strive to reach their own potential. The Ohio State University does not discriminate on the basis of age, ancestry, color, disability, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, race, religion, sex, gender, sexual orientation, pregnancy, protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. To learn more about diversity, equity, and inclusion and for opportunities to get involved, please visit: <https://odi.osu.edu/><https://odi.osu.edu/racial-justice-resources><https://odi.osu.edu/focus-on-racial-justice><http://mcc.osu.edu/>

Course Outline – next page

Table 1. Topics, Assignment Types, and Homework Dues

Week of (Module)	Overall Topic	Specific topics	Assignment types/Due
(1)	A General Concepts of Epigenetics	A1. Introduction of epigenetics A2. Epigenetics vs. Genetics	<ul style="list-style-type: none"> Syllabus Quiz (MUST BE TAKEN) Weekly Quiz, Discussion board, Practice activities (1/15)
(2)	B Environmental influences on the epigenome	B1. Environmental toxicants on the epigenome B2. Review of environmental investigations	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities 1/22
(3)	C Technologies and conduction of epigenome-wide association studies (EWAS)	C1. Overview of technologies of DNA methylation analyses C2. EWAS vs. GWAS, Interpretation of data	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities HW 1.a. (choosing 2 articles) HW 1.b. (summary of contribution) 1/29
(4)	D Tissue specificity and study design in epigenetics	D1. Use of non-target tissues in human investigations D2. Introduce statistical methods for cell type estimation	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities 2/5
(5)	E Exam	Exam-1	<ul style="list-style-type: none"> Exam-1 2/12
(6)	F Inherited disease of the methylation machinery	F1. Inherited diseases of the epigenetic machinery F2. Genomic imprinting in mammals – mechanisms	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities Online resource activity #1 2/19
(7)	G Epigenetics and nutrition	G1. Nutritional programming G2. Transgenerational effects	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities HW 2 (writing assignment) 2/26
(8)	H Epigenetics on aging and chronic diseases	H1. Epigenetic aging clock H2. Epigenetic aging and chronic diseases	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities Midterm course Evaluation (+ 3 bonus points) 3/5
(9)	I Environmental toxicants, epigenetics, and cancer	I1. Cancer epigenetics I2. Role of epigenetic alterations in chemical carcinogenesis	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities 3/12 HW 3.a. (draft slides) HW 3.b. (summary of contribution)
(10)	J Exam	Exam-2	<ul style="list-style-type: none"> Exam-2 3/26
(11)	K Environmental epigenetics on obesity	K1. Environmental contaminants and obesity K2. The obesity paradox and DNA methylation	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities Online resource activity #2 4/2
(12)	L Non-coding RNAs and novel topics in epigenetics	L1. Introduction to noncoding RNAs and environmental influences L2. New topics in epigenetics	<ul style="list-style-type: none"> Weekly Quiz, Discussion board, Practice activities 4/9
(13)	M Environmental Mitochondriomics and Epigenetic Biomarkers	M1. Environmental toxins, mitochondrial oxidation and mutations M2: Epigenetic biomarkers	<ul style="list-style-type: none"> Weekly Quiz (one for M1 and one for M2, 4/19), Discussion board (4/16), Practice activities (one for M1 and one for M2, 4/19)
(14)	N Summary section		<ul style="list-style-type: none"> Summary section, Step 1-3 4/23/ HW 4.a. (revise the slides) 4/23 HW 4.b. (summary of contribution) 4/23
(15)	O Oral presentation		<ul style="list-style-type: none"> Oral presentation (Final) 4/30 Oral presentation peer review/contribution 4/30

Table 2. Topics and Reading Materials

* Assigned readings are primary literature from recently published articles. Landmark historical articles are also indicated. Links to the PDF files of the paper can be opened by clicking on the citation through the Carmen site).

Week of (Module)		Overall topic	Readings materials*
(1)	A	General Concepts of Epigenetics	<ul style="list-style-type: none"> • Bob Weinhold. Epigenetics: The Science of Change. Environ Health Perspect. 2006 Mar; 114(3): A160–A167 • Goldberg AD et. al. Epigenetics: a landscape takes shape. Cell. 2007 Feb 23;128(4):635-8.
(2)	B	Environmental influences on the epigenome	<ul style="list-style-type: none"> • Hou L et.al. Environmental chemical exposures and human epigenetics. Int J Epidemiol. 2012 Feb;41(1):79-105 • Martin EM, Fry RC. Environmental Influences on the Epigenome: Exposure- Associated DNA Methylation in Human Populations. Annu Rev Public Health. 2018 Apr 1;39:309-333 • https://www.cdc.gov/niosh/topics/exposome/default.html
(3)	C	Technologies and conduction for DNA methylation analyses	<ul style="list-style-type: none"> • Michels K. Chapter4 laboratory methods in epigenetic epidemiology. Epigenetic Epidemiology. 2012 page37-55
(4)	D	Tissue specificity and study design in epigenetics	<ul style="list-style-type: none"> • Lokk et. al. DNA methylation profiling of human tissues identifies global and tissue-specific methylatin patterns. Genome Biology. 2014; 15(4): r54 • Michels et al. Recommendations for the design and analysis of epigenome-wide association studies. Nature Methods 2013 Oct;10(10):949-55.
(5)	E	Exam	Review reading materials
(6)	F	Inherited disease of the methylation machinery	<ul style="list-style-type: none"> • Jiang et. al. Epigenetics and human disease. Annu. Rev. Genomics Hum. Genet. 2004 5:479-510 • Tang and Ho. Epigenetic reprogramming and imprinting in origins of disease. Rev Endocr Metab Disord. 2007 June ; 8(2): 173–182
(7)	G	Epigenetics and nutrition	<ul style="list-style-type: none"> • Lim and Song. Chapter 23. Dietary and lifestyle factors of DNA methylation. Cancer Epigenetics. 2012 page 359-376 • Painter et.al. Transgenerational effects of prenatal exposure to the Dutch famine on neonatal adiposity and health in later life. BJOG. 2008 Sep;115(10):1243-9
(8)	H	Epigenetics on aging and chronic diseases	<ul style="list-style-type: none"> • Kim and Jazwinski. Chapter 8. Epigenome and aging. Environmental Epigenetics. 2015 page 155-196 • Horvath et. al. Obesity accelerates epigenetic aging of human liver. Proc Natl Acad Sci U S A. 2014 Oct 28;111(43):15538-43
(9)	I	Environmental toxicants, epigenetics, and cancer	<ul style="list-style-type: none"> • Park. Chapter 7. Environmental toxicant, epigenetics, and cancer. Environmental Epigenetics. 2015 page 131-154 • Pogribny and Rusyn. Environmental toxicant, epigenetics, and cancer. Adv Exp Med Biol. 2013 ; 754: 215–232
(10)	J	Exam	Review reading materials
(11)	K	Environmental epigenetics on obesity	<ul style="list-style-type: none"> • Su. Chapter 6. Environmental epigenetics and obesity: Evidences from animal to epidemiologic studies. Environmental Epigenetics. 2015 page 105-130 • Symonds et. al. The Obesity Epidemic: From the Environment to Epigenetics – Not Simply a Response to Dietary Manipulation in a Thermoneutral Environment. Front Genet. 2011; 2: 24
(12)	L	Non-coding RNAs and novel topics in epigenetics	<ul style="list-style-type: none"> • Karlsson and Baccarelli. Environmental health and long non-coding RNAs. Curr Environ Health Rep.2016 September ; 3(3): 178–187 • Bollati et. al. Exposure to metal-rich particulate matter modifies the expression of candidate miRNAs. Environ Health Perspect. 2010 Jun; 118(6): 763–768
(13)	M	Environmental Mitochondriomics and Epigenetic Biomarkers	<ul style="list-style-type: none"> • Roubicek et. al. Mitochondria and mitochondrial DNA as relevant targets for environmental contaminants. Toxicology. 2017. Nov 1;391:100-108 • Byun and Baccarelli. Environmental exposure and mitochondrial epigenetics: study design and analytical challenges. Hum. Genet. 2014 March ; 133(3): 247–257 • Mechanic and Hutter. Gene-Environment Interactions in Human. Environmental Epigenetics. 2015. Page 229-250 • Environmental Epigenomics: Applications of epigenetic biomarkers to investigate epigenetic alterations from environmental exposure. Environmental Epigenetics. 2015. page 251-280
(14)	N	Summary Section and HW-revised slides	
(15)	O	Summary Session/Oral Presentation	<ul style="list-style-type: none"> • Review reading materials • Oral presentation (Final)

Table 3. Alignment of Course Topics, Assignments, Course Learning Objectives, and Core/Specialization Competencies

Week of (Module)	Topics	Assignments	Foundational Public Health Knowledge Objectives	MPH: Foundational Competencies	MPH: Specialization in Environmental Public Health	MS: Specialization in Environmental Public Health	PhD: Foundational Competencies	PhD: Specialization in Environmental Public Health
(1)	A	General concepts of epigenetics	Quiz, Discussion, Practice activities	6,7,8	1	4	1	7
(2)	B	Environmental influences on the epigenome	Quiz, Discussion, Practice activities	6,7,8	1	4,6	1,2,7	1,2,5
(3)	C	Technologies, design, and conduction of epigenome-wide association studies (EWAS)	Quiz, Discussion, Practice activities, Choose a topic and two articles for presentation	6,7,8	1,4	4,6	1,2	1,2,5
(4)	D	Environmental influences on the epigenome	Quiz, Discussion, Practice activities	6,7,8	1	4,6	1,6	1,2,5,6
(6)	F	Inherited disease of the methylation machinery	Quiz, Discussion, Practice activities, Practice activities	6,7,8	1,4	4	1,6	1,2,5,6
(7)	G	Epigenetics and nutrition	Quiz, Discussion, Practice activities, Online resource activities	6,7,8	1	4,6,9	1,2,7,8	1,2,5
(8)	H	Epigenetics on aging and chronic diseases	Quiz, Discussion, Writing assignment	6,7,8	1	4,6,9	1,2,6,7,8	1,2,5,6
(9)	I	Environmental toxicants, epigenetics, and cancer	Quiz, Discussion, Practice activities, Draft slides	6,7,8	1	4,6	1,2,7,8	1,2,5
(11)	K	Environmental epigenetics on obesity	Quiz, Discussion, Practice activities, Online resource activities	6,7,8	1	4,6,9	1,2,7,8	1,2,5
(12)	L	Non-coding RNAs and novel topics in epigenetics	Quiz, Discussion, Practice activities	6,7,8	1	4,6,9	1,2,7,8	1,2,5
(13)	M	Environmental Mitochondriomics and Epigenetic Biomarkers	Quiz, Discussion, Practice activities, Revising slides	6,7,8	1	4,6,9	1,2,7,8	1,2,5
(14)	N	Summary section	Summary section	6,7,8	1	4,6,9	1,2,7,8	1,2,5
(15)	O	Oral Presentation	Review reading materials, Oral presentation	1, 2, 3, 4, 5, 6	10,11	3,5,6	1,2,3	1,2,5